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ABSTRACT

A random sample of 332 Philadelphians over the age of 18 was interviewed by telephone in order to investigate the relationships between social locator variables, general media exposure, media exposure to scientific information, and public attitudes toward issues dealing with medicine and health, science and defense, understanding the complexities of science, and the threat of scientific and technological advances. The social locator variables examined included sex, educational attainment, political conservatism, and a technological exposure index. Each respondent was asked a series of 59 questions. Data analysis revealed the following: (1) education was positively related to attitudes toward science, indicating a mastery of science and technical issues; (2) political conservatism was positively related to agreement that scientific and technological superiority were necessary to keep one safe from enemies; and (3) exposure to the science media was a significant predictor of attitudes toward science, while general media exposure appeared to be the least important predictor set. (HOD)

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Opinions About Science and Technology, Social Locator Variables and Mass Media Exposure: A Commonality Analysis

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Science and technology have become nearly as much a part of our daily lives as crime reports, political events, the Dow Jones Industrial Averages, and the weather. We live in an environment where the use of artificial hearts almost seems commonplace, where *Star Wars*, the name of a popular film, becomes associated with the debate over the development of new antiballistic missile systems for space, where "Super Fund" becomes part of our environmental vocabulary, and where just cleaning up the nation's worst nuclear power accident at Three Mile Island may threaten the health and safety of the cleanup crews.[1] Gene splicing, animal to human organ transplants, the artificial maintenance of human life after brain death, home computers for the academic success of children, nuclear winter, scientific literacy--the scientific and technical ideas we encounter daily have taken on the quality of "typical" news and have, to some considerable degree, become the basis of public and political debate. It is our purpose in this paper to explore how the mass media and other factors influence public's attitudes on some of these issues.

Interest about the influence of the mass media on public knowledge and attitudes toward science is not new. The most thorough study of these

relations was commissioned by the National Association of Science Writers and was completed at the Survey Research Center of the University of Michigan just before the October 4, 1957, Russian launching of Sputnik I. At that time, 83% of the 1919 adults sampled thought the world was better off because of science and that the positive effects of science included improving health, raising the standard of living, and making improvements in industry and technology possible. For the small percentage seeing negative effects associated with science, 6% feared atomic war and weapons development. The study also documented a consistent relationship between newspaper readership of science items and positive perceptions of the influence of science on society.[2]

When the Soviet Union launched Sputnik I, our national interest in science increased immediately. Media researchers went into the field to measure the possible impact of such an event on media coverage and audience response. Swinehart and McLeod used data from a survey of 1547 subjects completed just six months after Sputnik I.[3] Where 54% of the pre-Sputnik subjects had not heard of satellites, the figure fell to only 10% six months later. They also found some potentially negative outcomes resulting from advances in science. Whereas 32% of the public interviewed before the Sputnik launch had agreed with the statement that "the growth of science means that a few people could control our lives," the percentage increased to 40% after the launch. Most of this growth in negative attitudes toward science was among individuals who said they omitted reading science news in the press. Further, Swinehart and McLeod found that the number of media used for science information was strongly related to knowledge of science even after controlling for education They concluded that "both education and number of media used appear to be strong and independent predictors of satellite information."[4]

In a later summary article on the media as sources of knowledge of science, health and public affairs, Wade and Schramm advanced a model

describing the process of acquiring technical and science information.[5] They suggested that education provides people with ever increasingly complex conceptual maps. These maps are filled in by the media. Highly dramatic media such as television are best for filling in facts and findings but the addition of new concepts demands media capable of providing perspective and interpretation. This type of activity is best handled by print. Consequently, print is superior to television for complex and conceptually oriented science and health information.

Even as Wade and Schramm were presenting their summary piece, others expressed concern over what appeared to many as a growing distrust of science and technology. This distrust resulted from the public's identification of science with manipulation of the material world, with science's association with defense efforts, with the seemingly rapid depletion of scarce resources, with the growing technical emphasis in medicine, and with the often seeming incompatability between the goals of science and the needs of average people.[6] These new concerns helped to regenerate some of the interest in public attitudes toward science so common during the Sputnik era. This revived interest could be seen in the developing research emphasis on "scientific literacy," defined by Shen as ". . . an acquaintaince with science, technology, and medicine, popularized to various degrees, on the part of the general public and special sectors of the public through information in the mass media and education in and out of schools."[7]

Miller[8] extended the idea of "scientific literacy" in his 1983 review of the concept and suggested that three types of understanding are involved. First, it is necessary that the process of science be understood by the public. Second, the public needs to have the basic facts of the major sciences. Finally, a public understanding of the relationship between science, technology and society must be developed. For Miller, the articulation of the public's attitudes on science policy was dominated by about 20% of the public which he

labeled the "attentive public." This group, though not necessarily scientifically sophisticated, was actively interested in scientific events and interpretations. Their support for scientific issues could be mobilized and directed toward policy makers to influence science policy.

The growing concern about public attitudes resulted in increasing efforts to survey how the public felt about science. Beginning in 1972, the National Science Board began publishing a biannual summary of science indicators, including a section summarizing findings on the public's attitudes toward science and technology.[9] In general, their findings consistently pointed to a high level of public satisfaction with science and technology although the areas of public emphasis seemed to show some change over time. For example, in the 1982 report the percentage of people who felt too little was being spent in one area of applied science and technology--military armaments and defense-- increased steadily from 11% in 1973 to 27% in 1978, jumped to 56% in 1980, and fell back to 29% in 1982. The trend was reversed for those who thought too little was being spent on improving and protecting the enironment. In this area there was a steady decrease from 61% expressing concern in 1973 to 50% in 1982.

La Porte and Metlay[10] surveyed 980 adult Californians about their attitudes toward science ("the activity of discovering new knowledge and includes the development of prototype inventions"[11]) and, as a separate category, technology (". . . the activity which leads to the widespread availability of products based predominantly on scientific knowledge."[12]). They found that while 54% strongly agreed that scientists should be allowed to study things that don't appear to be beneficial now, 46% strongly agreed that science, while basically good, can be put to bad use. Also, while a majority disagreed with the idea that regulating invention reduces the quality of life, more people agreed than disagreed with the statement that no one knows enough to regulate which inventions are produced. They also found that

70% of their sample felt we had become too dependent on machines. Still, the majority of studies point to continued satisfaction with science[13] although when science and technology are separated, as with La Porte and Metlay, the results become less clear.

Efforts by communication scholars to investigate public exposure to scientific information and its impact on public opinion have taken several paths. One approach has been to interview scientists and journalists regarding their opinions about science information. Buchanan sampled 93 university scientists about their evaluations of science magazines.[14] He found that scientist's ratings of science magazines could be classified into three groups. The highest evaluated group included *Science, Nature* and *Scientific American*. The second level group included *Science News* and *Science 81*. The lowest ranked group was composed of *Omni* and *Discover*. The scientists stated that they relied on *Science, Scientific American* and *American Scientist*, in that order, for most of their science news. Ryan used a coorientation model to investigate the interrelationships between the attitudes of scientists and science journalists regarding science news.[15] His findings indicated that the attitudes of scientists and journalists were quite similar and that each group perceived a larger gap between their ideas and the ideas of the other group than actually existed. In an earlier effort, Tannenbaum used a more complicated model involving the mass media, the public, experts, TV commentators, and TV commentators' estimates of public ratings.[16] Tannenbaum compared the responses of the various groups regarding mental health. He found that the public, the experts, and TV commentators held similar views on public health, although the TV commentators' estimates of public attitudes differed considerably from the public's actual attitudes. Other studies have focused on the content of science articles[17] or on scientists' evaluation of the accuracy of science articles.[18]

Other investigators have attempted a more theoretical approach. Ettema,

Brown and Luepker used a health information campaign to test the "knowledge gap hypothesis" which proposes that higher SES groups in a community acquire mass media information more rapidly and more readily than lower SES groups. This results in knowledge differentials being created between the groups as information becomes more plentiful.[19] Their findings seemed to indicate that the introduction of health information in a community can actually reduce the knowledge differential between groups. They also found that education significantly predicted differences in knowledge before an information campaign, but that age and perceived risk were the major factors after the campaign. For the group receiving no new information, education remained the primary predictor for both pre-test and post-test scores.

Mellinger, Huffine and Balter also looked at public health issues in their study of public reactions to ethical issues in biomedical situations.[20] They found that education was the best predictor of the public's comprehension of the ethical issues involved in biomedical situations. They also found that respondents who had seen a doctor within a year of the interview also had higher comprehension rates than subjects who had not visited a doctor within the last year. They suggested that those seeking health care are probably more interested in medical issues and that they would have more favorable attitudes toward medicine. Unfortunately, they did not present any data on information use by these subjects.

McLeod, Glynn and Griffin investigated the relationship between demographic variables, media exposure, public affairs content, and energy communication on a number of knowledge, attitudinal, and behavioral measures relating to energy conservation.[21] They determined that public affairs exposure added significantly to the variance explained in salience, knowledge and attitudes about energy conservation for a white collar community but made a significant contribution only for salience in a blue collar community. In analyzing the effect of communication variables on knowledge, attitudes,

and behavior, the authors concluded that "the effect of communication was greater the more specifically energy related the variable was."[24] With the exception of their variable measuring salience, they found little support for any type of a gap based on status differentials.

The agenda setting effects of the media on a health related item were tested by Cook, Tyler, Goetz, Grodon, Protess, Leff, and Moltch.[25] In a novel experimental design, these researchers were able to randomly assign Chicago subjects to either watch an NBC television program exposing fraud in home health care or another program on a different channel at the same time. They interviewed experimental subjects, control subjects, and policy makers. A clear agenda setting effect was detected for those subject no saw the NBC program. Their evaluation of health care as an important issued increased after exposure. No change in attitude was noted for the control group. Governmental decision makers who knew of the program were likely to change their views on the seriousness of fraud and abuse in medical care while no such influence was noted for interest groups elites.

Another investigation undertaken by Tankard compared three models of public opinion formation in terms of their ability to predict knowledge and opinions about the nuclear freeze.[24] He found that both the subjects' knowledge about nuclear issues and their political ideology were related to attitudes toward a nuclear freeze. For instance, liberals were the most likely group to be supportive of a nuclear freeze while conservatives were least likely, regardless of their level of knowledge about nuclear issues. A similar pattern was found in subjects' willingness to delay a freeze until the United States and Russia were equal in terms of nuclear strength (the Administration's position) where conservatives were the most supportive across low, moderate and high knowledge groups while liberals were the least supportive and moderates took a middle position. Tankard concluded the article with a statement supporting a "cognitive consistency model"

(agreement between general attitudes and specific applications such as the nuclear freeze), limited support for an "enlightment model" (people will reject a belligerent foreign policy as they gain knowledge and sophistication on the subject), and no support for a "mainstream model" (as knowledge increases people are more likely to associate themselves with what they perceive to be the majority position).

While no general model of media influence on science and technical information has yet been developed, there seems to be a very consistent pattern of findings suggesting that both variables locating an individual in the social system and variables relating to media exposure have an influence on the information and attitudes people have toward science and technology. Van Liere and Dunlap reviewed the literature on environmental questions and found support for three general hypotheses relating to social location and environmental attitudes.[27] There is a negative relationship between age and attitudes expressing concern for the environment. A parallel relationship for media influence was noted by Davis[28] who found age negatively related to the recall of science items from the mass media. Similarly, Nunn[29] in a 1977 study found younger subjects more interested in science subjects than other age groups. Younger individuals seem to be more attentive to environmental issues and, perhaps, to science information in general. The second general hypothesis advanced by Van Liere and Dunlap indicates a very consistent and moderately strong relationship between education and environmental concern. Similar findings for the relationship between education and recall of science and medical information have been noted by Davis,[28] Michael,[29] and Miller.[30] Quite clearly, education operates as an important variable influencing people's interest and knowledge about science and science related subjects and may, as earlier suggested by Wade and Schramm[31], provide people with the type of cognitive structures allowing them to understand some of the complexities of science. The third general

hypothesis supported by Van Liere and Dunlap's review suggests that a strong relationship exists between political position (liberal to conservative) and a weaker but consistent relationship exists for political party regarding environmental issues. These findings were strongly supported for the nuclear freeze issue in the research of Tankard.[32]

No such systematic review of the research relating media exposure wit science and technology knowledge and opinion has been conducted but several generalizations are possible based on the existing evidence. Educational level is positively associated with exposure to mass media information about science and medicine.[33] Individuals with higher levels of education are more likely to read science magazines than less well educated individuals.[34] The sex of an individual seems to have, or had (in the late 50s) an influence on the type of science information sought, with women indicating higher liklihoods of reading about health matters while me... likely to read about general science.[35] A number of studies have shown that mass media exposure is related to knowledge, attitudes, and salience toward particular issues.[36]

Our intent in this study was to investigate the relationships between social locator variables, general media exposure, media exposure to science information, and public attitudes toward issues dealing with medicine and health, science and defense, feelings of ability to understand the complexities of science, and the threat of scientific and technological advances. In particular, we wanted to determine the independent and joint contributions of social locator variables and media exposure variables on science attitudes. To accomplish this we used a commonality analysis, a procedure for decomposing variation explained in a dependant variable in terms of the unique and common contribution to variance explained by the independent variables. It is a technique particularly suited to situations, such as this, where clear theory does not exist to guide the researcher in determining the relative importance of different independent variables.[37]

Methodology

A random sample of Philadelphians over the age of 18 was contacted by telephone during February of 1985. The respondents were selected using a random digit dialing procedure of both listed and unlisted phone numbers. All interviews were conducted between six and nine in the evening from the Drexel University Survey Research Center. The interviewers were all undegraduate students at Drexel University, currently taking courses in political science or communications. All those who participated received training in survey research techniques and were carefully monitored by the principal investigators. The sample size produced was 332 respondents. This sample produces results that are +/- 5.3% with 95% confidence.

Each respondent was asked a series of fifty-nine questions. The questions covered a variety of topics, however the main focus of the survey dealt with individuals' attitutes toward science and technology. A number of questions tapped their media use, both print and non-print. Particular emphasis was placed on determining not only the amount of media use, but also the type (science-nonscience) of newspaper, magazine or television content used by the repondent.

Predictor Variables

Three major categories of predictor variables were investigated in order to determine the relationship between attitudes toward scientific and technological questions. They were social locators, general media usage, and science media usage.

Social Locator Variables. The social locator variables examined included sex, educational attainment, political conservatism, and a technological exposure index. For the sex measure, males were coded as "1" and females as "0". The scoring for educational attainment ranged from "1" (less than a high school diploma) to "5" (attended graduate or professional school). Political

conservatism was coded based on the subject's response to the question, "Would you consider yourself a liberal, moderate, or conservative?" Liberals were scored with a "1", moderates with a "2", and conservatives with a "3". Those indicating other political positions were deleted from the analysis. The order of presentation for the political positions was rotated in order to remove any possible response order bias. The technological exposure index was developed using the individual's response to the question, "Is your work scientific or technologically oriented?" A score of "1" was recorded if the response was yes, "0" otherwise.

General Media Exposure. In examining the relationship between media exposure and attitudes towards science and technological issues a number of questions were asked regarding both print and non-print media usage. These variables included: frequency of reading newspaper stories about national and international politics and problems (scored 1=never to 4=frequently); responses to the question, "Do you regularly read any news magazines such as *Newsweek* or *US News and World Report*?" (yes=1, no=0); and the frequency of watching national news programs on television (1=never to 4=frequently).

Science Media Exposure. Science media exposure was also thought to be an important independent variable in affecting scientific and technological attitudes. To indicate their use of newspapers for science information, subjects were asked if they frequently (4), sometimes (3), rarely (2), or never (1) read stories "about medicine and health," "about the space program," and "other stories about science and technology." To determine science magazine use, respondents were asked if the regularly read science magazines such as *Scientific American* or *Discovery* (yes=1, no=0). To determine the use of television for science information, subjects were asked how often they watched "science programs such as 'Nova'" (never=1 to frequently=4).

Dependent Variables

A number of questions were available to tap the respondents' attitudes

on scientific and technological issues. Subjects responded "always" (1), "sometimes" (2), or "never" (3) to the following two questions:

SCTCH: "If science is the process of pure research and technology is the application of new discoveries to everyday life, do you feel that questions of how to use or not to use our science and technology are always, sometimes, or never too complex for you to vote on?"

CHNGS: "Do you feel that many of the current changes in science and technology are always, sometimes, or never too complicated for you to understand?"

A similar measure asked subjects about their attitudes toward advances in science and technology. Responses to this item ranged from feelings of being threatened (1) to feelings of being enthusiastic (4).

ADVS: "Do you feel enthusiastic, encouraged, neutral or threatened by the advances being made in science and technology?"

Subjects were also read a list of nine attitude statements with which they could agree (1), express no opinion (0), or disagree (-1). Two items were eliminated after an initial investigation of their correlations with the independent variables showed no significant relations with any of the independent measures. The remaining seven items were:

MEDSC: "Medical science will someday find cures for almost all types of disease."

PENV: "Almost all of our present environmental problems will someday be solved by new technologies."

NUCL: "It is inevitable that the United States and Russia will sign a nuclear disarmament agreement soon."

SCTST: "By an large, scientists and technicians are people who are trying to make the world a much better place."

ANMAL: "Someday medical science will make it possible to replace any human organ such as a heart or liver with animal or artificial organs."
MILIT: "This country would have a lot less to fear about war if we spent more of our space research money for military purposes."
SUPER: "The only true way we can ever be safe from our enemies is by maintaining our technological and scientific superiority."

To simplify the data analysis procedure, we attempted to reduce the number of variables for analysis by developing scales using the attitudinal items we had developed. We began by using an orthogonal varimax rotated principal components factor analysis on our ten attitude items. Four factors resulted from the analysis. Factor 1 was composed of three items (PENV, MEDSC, SCTST) and seemed to tap the subjects' positive feelings toward science. The second factor (CHNGS, SCTCH, ADVS) appeared to relate to feelings of mastery of scientific issues. Factor 3 (NUCL, SUPER) was tied to concerns about the relationship between science and technology and military matters. The fourth factor was difficult to interpret and included two seemingly unrelated items (ANMAL, MILIT). Because of the difficulty of interpretation, no attempt was made to develop this factor as a scale.

We next applied the elements of each factor to a reliability analysis to determine whether or not they could be combined into three separate scales. Cronbach's alpha reliability estimates for each factor were not encouraging. The estimates were: Factor 1, .42; Factor 2, .41; and Factor 3, .20. The low reliability values associated with each factor made it necessary for us to analyze the influence of our predictor variables on each attitude measure separately.[38]

Results

We started our analysis by investigating the zero-order intercorrelations between social locator, general media exposure, and science media exposure variables on the ten remaining attitude toward science measures. The results are presented in Table 1. Items were deleted from the list (PENV and FUTRS) if they failed to have at least two significant correlations ($p<.05$) with the independent variables.

Table 1 About Here

Differences in the interrelationships between the independent variables and the attitude measures are apparent. If one simply looks at the number of significant ($p<.05$) correlations for each of the independent measures, then certain patterns become clear. Using this criteria, education is the most influential social locator variable with significant correlations between it and five of the attitude measures. Education shows negative relationships with the belief that a nuclear disarmament agreement will be signed ($r=-.23$ for NUCL) and with agreement that we would be better off spending more space research money for military purposes ($r=-.27$ for MILIT). Education is positively related to the three attitude measures indicating mastery of science and technical issues ($r=.25$ for CHNGS, $r=.15$ for ADVS, $r=.15$ for SCTCH).

Three significant correlations are associated with the subject's sex. There is a negative correlation between being male and believing that science will someday find cures for most disease ($r=-.12$ for MEDSC). Males also seem less likely than females to think a disarmament treaty will occur soon ($r=-.12$

for NUCL). Finally, the correlation between feeling enthusiastic about technological advances and being male is positive (r=.17 for ADVS). Political conservatism is related positively to only one attitude, the feeling that we must maintain scientific superiority to be safe from our enemies (r=.22 for SUPER). Having a technologically related job shows a negative relationship with increased space research spending on the military (r=-.11 for MILIT) and a positive relationship with feeling able to understand changes in science and technology (r=.16 for CHNGS).

Only four significant relationships are found between the general media exposure variables and the attitudes toward science. The reading of a newspaper for news about national and international politics is significantly related to two attitudes: negatively to the feeling that scientists and technicians try to make the world a better place (r=-.14 for SCTST); and positively to feeling enthusiastic about scientific advances (r=.14 for ADVS). As with reading the newspaper about national and international politics, reading news magazines is negatively related to seeing scientists and technicians positively (r=-.12 for SCTST). TV network news viewing has only one statistically significant relation, a positive correlation with agreement that scientific superiority is necessary for national security (r=.18 for SUPER).

Where the general media exposure variables showed relatively few significant correlations with science attitudes, exposure to science media variables provides more promising findings. Reading newspaper science news and reading science magazines each has three statistically significant relationships. Newspaper science news reading shows significant positive correlations with believing that science would someday cure most disease (r=.13 for MEDSC), that changes in science and technology can be understood (r=.24 for CHNGS), and that advances in science and technology are encouraging (r=.16 for ADVS). Significant positive correlations exist between reading

science magazines and understanding changes in science (r=.20 for CHNGS), feeling enthusiastic about science (r=.13 for ADVS), and feeling competent to judge the complex issues associated with science and technology (r=.22 for SCTCH). Reading newspaper space news is positively associated with agreeing that science can someday cure most disease (r=.14 for MEDSC) and with feelings enthusiastic about scientific advance (r=.18 for ADVS). Only one significant relationship exists for each of the two remaining science media exposure variables: reading newspaper medical news (r=.14 for NUCL) and watching science programs on TV (r=.14 for ADVS).

Quite clearly, at least from correlational analysis, the strongest predictors are found among the social locator variables where education and sex, with five and three significant correlations respectively, dominante. Among the science media exposure group, reading newspaper science news and the reading of science magazines each has three significant correlations with the attitudinal variables. Furthur, most of the significant relationships between the attitudes and the social locator variables appear to cluster among the militarily oriented attitudes (NUCL, MILIT, SUPER) and the attitudes related to feelings of mastery over the issues involved with science and technology (CHNGS, ADVS, SCTCH). For science media exposure, most of the significant relations are observed with those attitudes indicating mastery of science and technology issues (CHNGS, ADVS, SCTCH).

The analysis of zero-order correlations, however, provides only a limited picture of the relationships between *all* of the variables we have used. As a part of the commonality analysis, we used a multiple linear regression on each of our attitude dependent variables. This type of analysis allowed us to investigate the relative contribution and importance of several variables used as predictors of our dependent variables by comparing *Betas* and their respective levels of statistical significance. Those attitudes where the overall F-ratio for the multiple regression analysis was not statistically

significant ($p<.05$) were eliminated from Table 2 and from future analysis (this included MEDSC, SCTST, and MILIT). The results of those multiple linear regression analysis with statistically significant F-ratios are presented in Table 2.

Table 2 About Here

The pattern evident in this table differs somewhat from what was presented in Table 1. Only the *Beta* (ß=-.21) for education is statistically significant for agreement with the statement that a nuclear disarmament agreement would be signed soon (NUCL). Seemingly, better educated individuals had little faith in any nuclear arms agreement between the United States and Russia. One social locator variable and one general media exposure variable are significantly related to the feeling that national security depended on technological and scientific superiority (SUPER). Here the *Betas* for political conservatism (ß=.17) and the watching of television network news (ß=.17) are positive and statistically significant. It seems reasonable to expect that conservatives might be more likely to agree with this statement than liberals. However, why the viewing of television network news would be positively associated with concern about the security needs for scientific and technological superiority is unclear.

The three variables dealing with feelings of mastery of technological and science issues (CHNGS, ADVS, SCTCH) are each related to only one of the social locator variables, education, with *Betas* of .20, .17, and .17 respectively. One general media exposure variable, national news magazine reading, shows a modest (ß=-.11) relationship with feeling encouraged by science and technological advance (ADVS). The strongest and most consistent predictors

for these three science mastery variables occurr among the science media exposure variables. Significant predictors for CHNGS included the reading of newspaper science news (ß=.31), the reading of newspaper medical news (ß=-.18) and the reading of science magazines (ß=.13). Two science media predictors are significantly related to ADVS. Here there is a negative *Beta* for newspaper medical news (-.13) and a positive *Beta* (.12) for science magazine reading. Two predictors are also significantly related to SCTCH. Newspaper reading for space news (ß=.15) and science magazine reading (ß= 20) each indicates that this specific type of reading is associated with feeling competent to make decisions involving science and technology.

Regression analysis does not, unfortunately, provide precise guidelines on which variables should be retained in a regression equation. The order of entry of a variable into a regression equation partly determines, that variable's contribution to variance explained by the regression model. Unless precise theoretical reasons exist to determine the order of entry, unlikely in many communication studies, regression results can be misleading. An alternative to the multiple regression procedure is commonality analysis. Commonality analysis has been recommended over the *t*-test as a method to be used in determining which variables should be retained in a regression model[39] and for determining which of a number of possible variables is most important in the development of regression models.[40]

The process of undertaking a commonality analysis consists of partitioning the variance explained in a multivariate analysis into unique and common components. The components of the partitioning of variance are shown graphically in Figure 1.

Figure 1 About Here

The total variation explained by a three element model can be represented by the Venn diagram in Figure 1. Each element has a unique contribution (A, B, C), a common contribution with each of the other two elements (AB, AC, BC), and a common contribution based on the joint influence of all three elements (ABC). The total variation explained by the three element model is the sum of the unique and common contributions of each element. Newton and Spurrell suggest that decisions to retain variables for further analysis be based on two criteria. First, retain those variables with substantial unique contributions. Second, when the common contributions are high in comparision to the unique contribution, the variable should be eliminated from the regression model.[41] While the details of calculating a commonality analysis are beyond the scope of this paper, excellent papers explaining the process exist [42] as well as applications of commonality analysis to communication studies.[43] The results of our commonality analysis are presented in Table 3.

Table 3 About Here

The largest unique contribution, 4.81%, to the variation explained for NUCL (agreement that a nuclear disarmament treaty will soon be signed) comes from general media exposure. Less variation is uniquely explained by science media (1.32%) and the unique explanation from social locators was too low (.68%) to be considered as an independent contributor. Most of the common variation explained comes from the social locator and science media groupings. Here the common contribution is 5.04%. The common contribution of -3.45% for general and science media represents a negative percentage of variation explained. This "supression effect" results when one of the

independent variables is more strongly correlated with another independent variable than it is with the dependent variable. For this particular variable, any clear cut interpretation is difficult. The only variable with a substantial unique contribution (4.81%), general media, also has a relatively high common contribution (-3.45%) with science media. For this particular attitude, any decision regarding the relatively importance of any predictor group would be unwarranted.

A clearer interpretation is possible for SUPER (national security by scientific and technological superiority). Here both social locator and general media variable groups have fairly substantial unique contributions of 4.49% and 2.58% respectively. No common contribution is above .61%. Consequently, both social locator and general media use variables should be considered for retention in future analyses. Science media usage, with its relatively low unique contribution of .91%, can safely be eliminated.

Science media use cannot be disregarded for the remaining attitudinal variables. For CHNGS (the idea that changes in science and technology can be understood), the unique contribution of science media usage is 9.07%, the largest unique contribution for any of the variables analyzed. The social locator variable group also has a relatively large unique contribution of 4.38%. The only fairly large common contribution, 3.14%, occurs for the social locator and science media groups. This figure, while fairly large, is still reasonably less than either of the unique contributions of these independent variable groups. Only general media use, whose unique contribution of 1.03% is comparatively low, should be deleted for future consideration.

A slightly different set of results can be seen for the remaining two attitudinal measures. For ADVS (feeling enthusiastic about scientific and technological advances), the highest unique contribution of 4.24% comes from the science media group. It is followed by the unique contribution of socal locators (3.71%), then general media use (1.83%). Only one of the common

contributions seems relatively high, the 1.92% for social locators and science media, but it is substantially less than the unique contribution from either component variable. Without a strong reason to do otherwise, it appears that all three variable groups are important contributors to the variation explained for ADVS.

The pattern shown for ADVS is duplicated for SCTCH (understanding the complexity of technolcgical and science issues). Here the largest unique contribution to variation explained comes from science media use (5.86%) followed by social locators (3.10%) and general media use (2.58%). The highest common contribution is for the social locator and science media group and it is a relatively low .73%. For this variable, as with ADVS, all three variable groupings should be retained.

Overall, a pattern seems clear from the commonality analysis. Science media use seems relatively unimportant for specific attitudinal statements. Science media usage seems unrelated to either agreement with the idea that a nuclear disarmament agreement will be signed soon (NUCL) or with believing that technological and scientific superiority is necessary for national security (SUPER). For both of these variables, general media use appears more important than science media use and the social locator variables seem to be most important as predictors of the second (SUPER) attitude. However, for more general feelings of mastery of the issues and complexities of science and technology (CHNGS, ADVS, SCTCH), science media use accounts for the greatest percentage of variation explained with social locators ranking second and general media use third.

Conclusion

We began this study with the purpose of investigating the relationships between social locator variables, general media exposure, and science media

exposure with public attitudes toward science and technology. Based on our commonality analysis, we found that the social locator variables of sex, educational level, political conservatism, and technological exposure explained comparatively sizable portions of the variance in four of the five science attitude variables we investigated. Using multiple linear regression analysis, the most important predictor variable from the social locator group of variables seemed to be the individual's educational level. The only other social locator variable to have a significant *Beta* weight was political conservatism. Here conservatism was positively related to agreement that scientific and technological superiority are necessary to keep us safe from our enemies.

Most importantly, we found that exposure to science media was a significant predictor of three of the five measured attitudes toward science. These relationships were detected in both the multivariate regression and the commonality analyses that we used. In the commonality analysis, we discovered that the unique contribution of science media exposure to the three attitudes related to feelings of mastery of science and technological issues surpassed the unique contributions of both the social locator and general media use variables for these three attitudes.

General media exposure appeared to be the least important predictor set. This finding seems reasonable. Although newspapers, news magazines, and television network news do carry science stories, it is likely that individuals with an interest in science and technology make special efforts to seek out science information either from specialized publications such as science magazines or through selection of special television programs such as "Nova."

Another observation that seems justified is that media influence seems related to the type of attitude being measured. Very specific attitudes, such as agreement about the use of science and techology in national security matters and expectations that a nuclear disarmament treaty will be signed

soon, appear to be relatively independent of science media exposure, at least as we have measured it. For these types of beliefs, social location and general media exposure may provide people with a general orientation to issues involving factors other than science and technology. Here, it is national security, not physics, that guides our beliefs. However, less specific attitudes related to general feelings of competentence about science and technology are directly related to the consumption of specialized science content in the media.

Our findings, while consistent and reasonable, are not overpowering. The largest percentage of variation any of our models managed to explain was just over 17%. And while the highest unique contribution of science media exposure was just 9.1% of the variation explained for any of the attitudinal variables we used, this percentage is still nearly twice as high as the highest unique contribution for either the social locator or general media groups. We feel confident we have demonstrated that science media exposure can be at least as important in explaining people's attitudes toward science and technology as the more traditionally used social locator variables of education and sex. We stop short of making any causal claims. It is as likely that people who feel confident about their science knowledge and who have positive attitudes toward science and technology seek out technical and science information as it is that people who consume science information develop favorable science attitudes. The process of cause is undoubtably reciprocal. Nevertheless, our findings that science media exposure provides explanatory power beyond education does at least suggest that science media exposure may have a causal influence on some science attitudes.

The next studies of media exposure and science attitudes should define science and technology separately to thus allowing investigatation of possible differences in the way people respond to them as different issues. Problems of measurement must be addressed in future studies with more attention paid

to the instruments measuring attitudes toward science. The development of reliable and valid attitude scales and media exposure measures should work to strengthen measured relationships and to increase the variation explained in the dependent variable set. Finally, future research efforts should attempt to replicate the work of Cook et al. using panel studies to investigate the influence of media coverage of a new science area, but on science topics less sensational than health care fraud.[44] Such investigations should significantly increase our knowledge of the precise relationship between media coverage of science issues and the public's attitudes toward and knowledge of such issues.

Notes

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[3]James W. Swinehart and Jack M. McLeod, "News about Science: Channels, Audiences, and Effects," *Public Opinion Quarterly* 24: 583-589 (1960).

[4] *Ibid*, p. 589.

[5]Serena Wade and Wilbur Schramm, "The Mass Media as Sources of Public Affairs, Science, and Health Knowledge," *Public Opinion Quarterly* 33: 197-209 (1969).

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[7]Benjamin S. P. Shen, "Scientific Literacy and the Public Understanding of Science," in Stacey B. Day, ed., *Communication of Scientific Information* (Basel, Switzerland: S. Karger, 1975), pp. 45-46.

[8]Jon D. Miller, "Scientific Literacy: A Conceptual and Empirical Review," *Daedalus* 112 (2): 29-49 (1983).

[9]National Science Board, *Science Indicators 1972, Science Indicators 1974, Science Indicators 1976, Science Indicators 1980, Science Indicators 1982* (Washington, D.C.: Government Printing Office, 1973, 1975, 1977, 1981, 1983).

[10]Todd R. La Porte and Daniel Metlay, "Technology Observed: Attitudes of a Wary Public," *Science* 188: 121-127 (1975).

[11] *Ibid*, p. 123.

[12] *Ibid*, p. 123.

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[16]Percy H. Tannenbaum, "Communication of Science Information," *Science* 140: 579-583 (1963).

[17]Carroll J. Glynn and Albert R. Tims, "Sensationalism in Science Issues: A Case Study," *Journalism Quarterly* 59: 126-131; Vicki S. Freimuth, Rachel H. Greenberg, Jean DeWitt, and Rose Mary Romano, "Covering Cancer:

Newspapers and the Public Interest," *Journal of Communication* 34 (1): 62-73 (1984). The issue of the coverage of cancer by the mass media is also discussed in "Views of Scientists and Journalists on How the Media Cover Cancer," *SIPIscope* 11 (3) (September-October, 1983).

[18]James W. Tankard and Michael Ryan, "News Source Perceptions of Accuracy of Science Coverage," *Journalism Quarterly* 51: 219-225, 334 (1974); Bill Kovarik, "Science News at the Crossroads: A Study of News Accuracy at the 1982 AAAS Conference." Paper presented to the Association for Education in Journalism and Mass Communication, 1984.

[19]James S. Ettema, James W. Brown, and Russell Luepker, "Knowledge Gap Effects in a Health Information Campaign," *Public Opinion Quarterly* 47: 516-527 (1983).

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[26]Davis, *op. cit.*

[27]Clyde Z. Nunn, "Readership of Science and Technology in Newspapers," *Journalism Quarterly* 56: 27-30 (1979).

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[29]Michael, *op. cit.*

[30]Miller, *op. cit.*

[31]Wade and Schramm, *op. cit.*

[32]Tankard, *op. cit.*

[33]Davis, *op. cit.*; Swinehart and McLeod, *op. cit.*; Miller et al., *op. cit.*

[34]Wade and Schramm, *op. cit.*; Miller et al., *op. cit.*

[35]Davis, *op. cit.*

[36]Etteme et al., *op. cit.*; Cook et al., *op. cit.*; McLeod et al., *op. cit.*; Swinehart and McLeod, *op. cit.*; Withey, *op. cit.*

[37]Fred N. Kerlinger and Elazar J. Pedhazur, *Multiple Regression in Behavioral Research* (New York: Holt, Rinehart and Winston, 1973).

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[39]R. G. Newton and D. J. Spurrell, "Examples of the Use of Elements for Clarifying Regression Analyses," *Applied Statistics* 16: 165-172 (1967).

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[41] *Ibid*

[42]For thorough discussion of the use of commonality analysis refer to Kerlinger and Pedhazur, *op. cit.* and David R. Seibold and Robert D. McPhee, "Commonality Analysis: A Method for Decomposing Explained Variation in Multiple Regression Analyses," *Human Communication Research* 5: 355-365 (1979).

[43]See Dan Slater and William R. Elliott, "Television's Influence on Social Reality," *Quarterly Journal of Speech* 68: 69-79 (1982); William R. Elliott and Robert L. Rudd, "Evaluating Dimensions of Television Program Reality: A Commonality Analysis of Perceived Superficiality, Perceived Plausibility and the Degree of Personal Utility." Paper presented to the Association for Education in Journalism and Mass Communication, August, 1984.

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Table 1

Zero-Order Intercorrelations Between Attitudes Toward Science, Social Locater and Media Exposure Variables

	Attitudes Toward Science							
Independent Variables	MEDSC	SCTST	NUCL	MILIT	SUPER	CHNGS	ADVS	SCTCH
Social Locators								
Sex[c]	-.12[a]	-.01	-.12[a]	-.03	.01	.07	.17[b]	.07
Education	-.04	-.08	-.23[b]	-.27[b]	-.10	.25[b]	.15[b]	.15[b]
Political Conservatism[d]	-.06	-.07	.07	.07	.22[b]	-.06	.00	.05
Technological Exposure	.00	-.03	-.05	-.11[a]	.02	.16[b]	.05	.10
General Media Exposure								
Newspaper National and International News	.00	-.14[a]	.09	-.09	.03	.06	.14[a]	.04
News Magazines	.02	-.12[a]	-.08	.01	-.05	.00	-.06	.02
TV Network News	.02	-.02	.03	-.05	.18[b]	.06	.07	.02
Science Media Exposure								
Newspaper Science News	.13[a]	-.02	-.01	-.06	.02	.24[b]	.16[b]	.07
Newspaper Space News	.14[a]	.02	.03	-.11	.06	.08	.18[b]	.11
Newspaper Medical News	.05	-.03	.14a	-.02	-.01	-.04	-.04	.02
Science Magazines	.04	-.07	-.11	-.05	-.03	.20[b]	.13[a]	.22[b]
TV Science Programs	.06	-.08	-.02	-.07	-.04	.05	.14[a]	.10

[a] Correlations significant at $p < .05$, for all correlations $N \geq 267$.

[b] Correlations significant at $p < .01$.

[c] The sex variable was coded with Male = 1, Female = 0.

[d] The coding for political conservatism was 1 = liberal, 2 = moderate, 3 = conservative.

Table 2

Multiple Linear Regression Analysis (β Weights)
of Attitudes Toward Science by Social Locator
and Media Exposure Variables

	Attitudes Toward Science				
Independent Variables	NUCL	SUPER	CHNGS	ADVS	SCTCH
Social Locators					
Sex	-.10	-.01	-.03	.10	.02
Education	-.21[c]	-.07	.20[c]	.17[c]	.17[b]
Political Conservatism	.03	.17[c]	-.06	.02	.09
Technological Exposure	.04	.05	.06	-.11	.00
General Media Exposure					
Newspaper National and International News	.08	.02	-.06	.08	-.02
News Magazines	-.06	-.05	-.07	-.11[a]	-.01
TV Network News	-.01	.17[b]	.07	.06	.02
Science Media Exposure					
Newspaper Science News	.02	-.01	.31[c]	.01	-.12
Newspaper Space News	-.06	.10	-.02	.11	.15[a]
Newspaper Medical News	.12	-.04	-.18[c]	-.13[a]	-.01
Science Magazines	-.05	-.03	.13[b]	.12[a]	.20[c]
TV Science Programs	.04	-.09	-.06	.07	.05
Multiple R^2	.085[b]	.086[b]	.174[c]	.127[c]	.103[b]
N	263	246	261	256	246

[a] $p \leq .10$
[b] $p \leq .05$
[c] $p \leq .01$

Table 3

Commonality Analysis of Attitudes Toward Science by
Social Locator and Media Exposure Variable Groups

Variation Explained by Independent Variable Groups	Attitudes Toward Science				
	NUCL	SUPER	CHNGS	ADVS	SCTCH
Unique to 1, Social Locators[a]	.68%	4.49%	4.38%	3.71%	3.10%
Unique to 2, General Media[b]	4.81%	2.58%	1.03%	1.83%	2.58%
Unique to 3, Science Media[c]	1.32%	.91%	9.07%	4.24%	5.86%
Common to 1 and 2	.21%	.61%	- .70%	.28%	.04%
Common to 1 and 3	5.04%	.50%	3.14%	1.92%	.73%
Common to 2 and 3	-3.45%	- .22%	- .36%	- .11%	.06%
Common to 1, 2 and 3	- .13%	- .29%	.88%	.78%	.44%
Total Variation Explained	8.48%	8.58%	17 44%	12.65%	10.28%
N	263	246	261	256	246

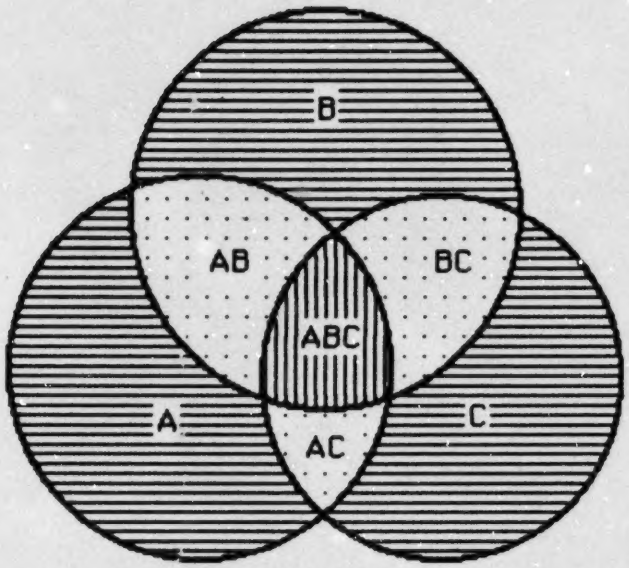
[a]The social locator variable group was composed of the variables measuring sex, education, political conservatism, and technological exposure.

[b]The general media variable group was composed of the variables measuring newspaper use for national political news, news magazines, and TV network news.

[c]The science media variable group was composed of the variables measuring newspaper reading of science news, newspaper reading of space news, newspaper reading of medical news, science magazines, and TV science programs.

Figure 1

Commonality Analysis
Components of Variance Explained



UNIQUE CONTRIBUTION OF VARIABLE A, B, C

COMMON CONTRIBUTION OF VARIABLE PAIRS AB, AC, BC

COMMON CONTRIBUTION OF ALL THREE VARIABLES ABC